Refrigerating Apparatus

The invention relates to refrigerating apparatus. The invention relates particularly, but not exclusively, to refrigerating apparatus suitable for chilling objects rapidly. The invention further relates to a method of refrigeration.

Conventional refrigerating apparatus comprises means for generating and maintaining a low temperature environment in which to store food or beverages. However, it is often desirable to chill an object, for example, a bottle of wine or beer, quickly. This is not readily achievable by leaving the bottle in a refrigerator as it takes a considerable time before the contents of the bottle are chilled to the desired temperature. Often, in order to speed up the chilling process, the consumer places the bottle in a freezer. However, this method has the disadvantage that it is not easily controllable and it relies on the consumer remembering to take the bottle out of the freezer before the contents freeze. An example of an apparatus for chilling an object more quickly is shown in US 4,358,932 which describes a system of introducing cold air, taken directly from the freezer compartment of a refrigerator, to a chamber containing a bottle. The cold air enters the chamber at the base and flows upwardly, in the direction of the longitudinal axis of the chamber. As the cold air passes the bottle, heat is transferred from the bottle and its contents to the cold air, thereby causing the temperature of the contents to fall. However, the amount of time taken to chill the contents may still be unsuitably long for the consumer's needs. For example, following the calculation given in US 4,358,932, a 1 litre bottle would take 23 minutes to chill to from 75°F to 35°F.

The type of arrangement shown in the prior art has the disadvantage that only a small area of the bottle is in direct contact with the cold air and the residency time of the cold air passing the bottle is short. Therefore, heat transfer from the bottle and its contents to the cold air is not maximised. Additionally, the air flow through the chamber is not particularly turbulent and so heat exchange is relatively inefficient.

It is an object of the present invention to provide a refrigerating apparatus suitable for chilling objects rapidly.

The invention provides refrigerating apparatus for chilling an object, the refrigerating apparatus forming part of a refrigerator and comprising a chamber having a longitudinal axis, an inlet and an outlet spaced along the longitudinal axis, the refrigerating apparatus further comprising means for generating a fluid flow, characterised in that rotation means are provided for causing the fluid flow to follow a helical path about the longitudinal axis within the chamber between the inlet and the outlet. In this configuration, there is an increase in the contact time between the fluid flow and the object. Therefore, heat transfer is more efficient which leads to a reduction in the time taken to chill the object.

Preferably the inlet is arranged tangential to the chamber so as to cause the fluid flow to follow a helical path about the longitudinal axis within the chamber. Provision of the tangential inlet ensures helical fluid about the object which maximises the contact time during which heat transfer occurs.

Preferably a support is provided for supporting the object spaced from a wall of the chamber. The support ensures that the object is placed in the chamber in an optimum position for heat transfer.

In a preferred embodiment, the apparatus comprises a plurality of chambers, each chamber being dimensioned so as to house an object to be chilled. It is an advantage to be able to chill a number of objects simultaneously. This is particularly suitable for use in, for example, restaurants where it is desirable to have a large number of alternative beverages available on demand.

The invention further provides a method of chilling an object in a refrigerator, comprising the steps of:

a) placing an object to be chilled in a chamber in the refrigerator, the chamber having a longitudinal axis, an inlet and an outlet spaced along the longitudinal axis;
b) introducing a fluid flow to the inlet of the chamber;

c) causing the fluid flow to follow a helical path about the longitudinal axis and around the object to be chilled;

and

d) allowing the fluid flow to exit the chamber via the outlet.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, wherein:

Figure 1 is a schematic view of a first embodiment of refrigerating apparatus according to the invention, the embodiment being illustrated here with a wine bottle housed therein;

Figure 2 is a schematic view of a second embodiment of refrigerating apparatus according to the invention;

Figure 3 is a schematic view of the apparatus of Figure 1 in combination with other elements; and

Figure 4 is a schematic view of a third embodiment of refrigerating apparatus according to the invention.

Figure 1 shows a first embodiment of refrigerating apparatus 10 according to the invention. The refrigerating apparatus 10 comprises a chamber 12 having first end wall 14, a second end wall 16 and a cylindrical wall 20 extending therebetween. The chamber 12 is thus generally cylindrical and has a longitudinal axis 18. It will be appreciated that the chamber can be of any shape suitable for receiving and housing an object to be chilled. An inlet 22 for introducing a chilled fluid flow to the chamber 12 is provided at a first end 12a thereof adjacent the first end wall 14. The inlet 22 is circular in cross-section and communicates tangentially with the chamber 14. An outlet 24 for carrying the fluid flow out of the chamber 12 is provided at a second end 12b thereof adjacent the second end wall 16. The outlet 24 is circular in cross-section and

communicates tangentially with the chamber 12. The inlet 22 and the outlet 24 are spaced apart along the axis 18.

Figure 1 shows a wine bottle 26 housed in the cylindrical chamber 12 but it will be understood that the wine bottle 26 may be replaced with any suitable object that the consumer wishes to chill. Equally, the chamber 12 may be shaped and dimensioned so that other objects may be conveniently received and stored therein. A stand 28 is provided on the second end wall 16 to allow the object (here the wine bottle 26) to be supported. The stand 28 is located and arranged so that, when the wine bottle 26 is supported thereon, it is located substantially centrally of the chamber 12. The stand 28 has a platform 30 and a plurality of legs 32 which ensure that the platform 30 is spaced from the second end wall 16. Hence, a gap is provided between the second end wall 16 and the platform 30 on which the wine bottle 26 is supported.

The refrigerating apparatus 10 shown in Figure 1 operates in the following manner. A chilled fluid flow, preferably air, is introduced into the first end 12a of the chamber 12 via the inlet 22. The tangential arrangement of the inlet 22 with respect to the chamber 12 causes the incoming chilled fluid to follow a generally helical path around the cylindrical wall 20 whilst it moves along the axis 18 in the direction of the outlet 24. A simplified version of the path followed by the fluid is shown in Figure 1. The helical path followed by the fluid is considerably longer than a direct path between the inlet 22 and the outlet 24. Furthermore, by forcing the fluid to follow a helical path, the turbulence created in the fluid flow improves the transfer of heat away from the object 26 to be cooled.

The fluid flow exits the chamber 12 via the outlet 24 which communicates with the second end 12b of the chamber 12. The fact that the platform 30 is spaced apart from the second end wall 16 means that the fluid flow can pass underneath the platform 30 before it exits the chamber 12. The fluid flow is therefore able to cool the stand 28 by transferring heat energy away from it. This is particularly effective if the stand 28 is

made from a thermally conductive material, eg. metal. If the stand 28 is cooled, this can also assist with the cooling of the object 26.

A second embodiment of the invention is shown in Figure 2. This embodiment differs from the first embodiment in that the refrigerating apparatus 100 comprises an inlet 122 and an outlet 124 which are coincident with the longitudinal axis 118 of the chamber 112. Further, a fan assembly 128 is provided at the first end 114 adjacent the inlet 122. The fan assembly 128 is illustrated in Figure 2 as lying generally on the longitudinal axis 118 but the position of the fan assembly 128 may be altered so as to cause the incoming fluid flow to follow a helical path down the chamber 112. The method of use of the apparatus shown in Figure 2 is essentially the same as that of Figure 1. A chilled fluid flow enters the chamber 112 via the axial inlet 122. The fan assembly 128 is caused to rotate so as to force the incoming fluid flow to travel along a generally helical and somewhat turbulent path about the longitudinal axis 118 of the chamber 112. It will be appreciated that alternative means of causing the incoming axial fluid flow to follow a helical path could replace the fan assembly 128. For example, fixed vanes could be employed to create the same effect. What is important is that the incoming fluid flow is forced to follow a generally helical and turbulent path within the chamber 112.

Figure 3 illustrates the apparatus shown in Figure 1 and described above in combination with other elements. The apparatus 10 is connected via the inlet 22 and the outlet 24, in combination with further pipe work, to a chamber 140. An evaporator 150 is located inside the chamber 140, along with a fan assembly 152. Preferably, the pipe work connecting the apparatus 10 to the chamber 140 is thermally lagged, as is the chamber 140. In use, liquid refrigerant (for example, butane or hydrofluoroalkane) is pumped at low pressure into the evaporator 150 via an inlet 154. The low pressure of the liquid refrigerant causes it to evaporate into a gas. The change in the physical state of the refrigerant causes an exothermic reaction whereby heat is lost from the liquid and the liquid rapidly cools causing the temperature in the evaporator 150 to drop. The fan assembly 152 generates a flow of air which passes across the evaporator 150 and becomes chilled. It is then passed towards the chamber 12 (the direction of flow is

shown by arrows A in Figure 3). The chilled air enters the chamber 12 via the inlet 22 and is caused to follow a helical path 160 around the object to be chilled, passing from the first end 12a of the chamber 12 towards the second end 12b. The contact time between the object and the chilled air is greatly increased because of the helical nature of the flow. In this way, heat transfer from the object to the chilled air is maximised and the object rapidly losses heat and cools down.

The air exiting the chamber 12 via the outlet 24 is at a higher temperature than the chilled air entering at the inlet 22 because of the heat transfer process. However, the exiting air can be circulated back to the evaporator 150 for rechilling. The heat generated by the process is exchanged within the evaporator where it can be removed from the system by means of a conventional compressor and condenser system. It will be appreciated that the apparatus illustrated in Figure 2 can replace the apparatus 10 used in the system shown in Figure 3.

Figure 4 shows a third embodiment of the invention. The refrigerating apparatus 200 comprises an arrangement of chambers 212 each having the same configuration as the chamber 12 of Figure 1. It will be appreciated that the chambers 212 could alternatively have the configuration of that shown in Figure 2. Each chamber 212 has a tangential inlet 222 and a tangential outlet 224. At least one main inlet 226 (two are shown here) feeds chilled air into the refrigerating apparatus 200 and a proportion of the chilled air is directed into each inlet 222. The chilled air follows a helical path downwardly through each chamber 212 before exiting via the respective outlet 224 as previously described. The exiting air is carried away via one or more main outlets 228. The number and arrangement of chambers 212 is not limited to that shown in the figure. This arrangement is beneficial when a number of objects require to be chilled simultaneously.

The invention is not intended to be limited to the precise features of the embodiments described above. Other variations and modifications will be apparent to a skilled reader. For example, as has been mentioned, the chamber may be of any suitable shape

to hold the object to be chilled. Also, the fluid used to chill the object need not be air but could be any suitable fluid. In some circumstances, the fluid could be a liquid, eg. water.